MAINE YANKEE FINAL STATUS SURVEY RELEASE RECORD FR-0111 YARD WEST EXCAVATIONS SURVEY UNIT 3

Prepared By:	<u>J. Anduroon</u> FSS Engineer - Signature D. ANDERSON	Date: <u>ا ۲۱/۲/۵4</u>
	Printed Name	
Reviewed By:	Lany Dehi- FSS Specialist - Signature	Date: 12/17/04
	Larry Docking Printed Name	
Reviewed By:	Independent Review - Signature	Date: 12 /20 /04
	U.J. Cierze	
Approved By:	Superintendent, FSS- Signature	Date: 12/20/04
	George Tilsburg Printed Name	
Approved By:	FSS, MOP - Signature	Date: <u>12/22/01/</u>
	<u>Jomes R. Recen</u> Printed Name	

MAINE YANKEE FINAL STATUS SURVEY RELEASE RECORD FR-0111 YARD WEST EXCAVATIONS SURVEY UNIT 3

A. SURVEY UNIT DESCRIPTION

FR 0111 Yard West Excavations Survey Unit 3 consisted of a 564.1 m² elongated excavation that extended along the former Spray Building foundation and Personnel Hatch slab into the area commonly known as the "alleyway" (overlapping portions of survey area FR 0110 Survey Units 1, 2, and 5) within the Restricted Area back yard. The survey unit was located at coordinates 407,475 N and 623,850 E using Maine State Coordinate System (West Zone) NAD 1927. It was bounded on the east by the former Service Building footprint, on the south by FR 0111 Survey Units 4 and 7, on the west by FR 0111 Survey Unit 4, and on the north by concrete foundation left from the former Spray Building and Personnel Hatch. The location of the survey unit in relation to the Containment Building and the surrounding FR 0111 survey units is shown on Map FR0111U3-SITE (Attachment 1).

The excavation was created as a result of the removal of contaminated sub-surface soil from locations S121 and S122 as identified in Characterization Package CR 5000. Demolition and removal of all or a portion of the following systems and foundations contributed to the size of the excavation:

- Piping systems that exited the south side of the Spray Building
- Demineralized Water Storage Tank (DWST) concrete foundation to 3-ft. below grade
- Entire Gas House concrete foundation
- Portions of the storm drain system
- Primary Component Cooling (PCC)/Secondary Component Cooling (SCC) piping and other miscellaneous yard piping.

The remaining excavation was generally 3 meters (10 ft.) below grade with two deep holes that fell 7.6 meters (25 ft) below the normal elevation. The survey unit was approximately 10 meters wide and 40 meters in length. The survey unit dimensions are illustrated on map FR0111U3-06.

B. SURVEY UNIT DESIGN INFORMATION

Survey Unit 3 met the LTP Revision 3 definition for a Class 1 survey unit. The survey unit design parameters are shown in Table 1. Given an adjusted relative shift of 3.0, it was determined that 14 direct measurements were required for the Sign Test. Because the measurement locations were based on a systematic square grid with a random start point, the N=14 design led to a survey unit map with 19 locations. The direct point locations are illustrated on map FR0111U3-05 (Attachment 1). Direct measurements consisting of soil, rock, ledge or concrete samples were collected from required locations and analyzed with laboratory gamma spectroscopy instrumentation.

In accordance with the LTP, scans covering 100% of the 564.1 m² area were required for the Class 1 survey unit. This was accomplished by use of an *in situ* gamma spectroscopy detector configured at a 3-meter distance from the surface to obtain overlapping 28-m² fields of view. Locations of the 35 survey scans are shown on map FR0111U3-03.

Additional ISOCS scans were performed in the following geometries to ensure all terrain levels within the survey unit were scanned:

- ISOCS scans were performed on the concrete foundation of the former Spray Building and Personnel Hatch and ledge along the north boundary of the survey unit. A total of 21 horizontal gamma scans were performed using the 90-degree collimator at a distance of 2 meters from the concrete/ledge surface to obtain overlapping 12 m² fields of view. Locations of horizontal scans are provided on map FR0111U3-04 (Attachment 1).
- ISOCS scans were performed 9 inches from the 4 PCC/SCC pipe ends located in the Spray Building wall using a 90-degree collimator. Locations of the scans are provided on map FR0111U3-04 (Attachment 1).
- Two ISOCS scans were performed on holes left by the demolition and removal of the yard pipes. The gamma scans were performed at a distance of 9 feet from the excavated floor using the 180-degree collimator. Locations of the vertical scans are provided on map FR0111U3-02 (Attachment 1).

The combination of all ISOCS scans conservatively ensured 100% scan coverage of all exposed surfaces within Survey Unit 3. The survey instruments used are listed by model and serial number in Attachment 2 (Table 2-1). Scan MDCs are also listed in Attachment 2 (Table 2-2) and are compared to the DCGL, the investigation level, and the DCGL_{EMC}. As shown in this table, the scan MDC is less than the scan investigation level, thus providing high confidence (95% or higher) that an elevated area would be detected in the scanning process. Further, since the investigation level was always less than the design DCGL_{EMC}, no EMC sample size adjustment was necessary.

TABLE 1

SURVEY UNIT DESIGN PARAMETERS

Survey Unit	Design Criteria	Basis		
Area	564.1 m ²	Class 1, < 2,000 m ²		
Number of Direct Measurements Required	14	Based on an adjusted LBGR of 2.18 pCi/g, sigma ¹ of 0.07 pCi/g, and a relative shift of 3.0. Type I = Type II = 0.05		
Sample Area	40.29 m ²	$564.1 \text{ m}^2 / 14 = 40.29 \text{ m}^2$		
Sample Grid Spacing	6.34 m	(40.29) ^{1/2}		
Scan Grid Area	ISOCS scan at 3-meters	Reference 6		
Area Factor	1.5	Class 1 Area, LTP Table 6-12		
Scan Area	564.1 m ²	Class 1 Area – 100%		
Scan Investigation Level	1.0 pCi/g Cs-137 0.36 pCi/g Co-60	ISOCS investigation levels with detector at 3-meter height (Reference 6)		
Scan myestigation Lever	2.2 pCi/g Cs-137 0.8 pCi/g Co-60	ISOCS investigation levels with detector at 2-meter height (Reference 6)		
DCGL	2.39 pCi/g Cs-137 0.86 pCi/g Co-60	Reference 4		
Design DCGL _{EMC} 3.58 pCi/g Cs-137 1.29 pCi/g Co-60 1.29 pCi/g Co-60		DCGL x Area Factor for Class 1 survey unit, per LTP Section 5.6.3		

C. SURVEY RESULTS

A total of 19 direct measurements were performed in Survey Unit 3. The results are presented in Table 2. All direct measurements were below the DCGL.

ISOCS gamma scans were performed at 62 locations using various geometries discussed in Section B. The gamma scans were performed for a sufficient count time to achieve a Minimum Detectable Activity of approximately 25% of the DCGL. Four gamma scans identified potentially elevated activity above the Co-60 investigation level. One location that exceeded the investigation level used an ISOCS scan at 3 meters from the surface. A second location occurred on vertical concrete surface with the ISOCS detector configured at a distance of 2 meters. Two additional locations were identified during the ISOCS scan of the pipes. The subsequent investigation evaluation work is discussed in the following section.

¹ Based on post-remediation sample standard deviation.

TABLE 2

Sample Number	Cs-137 (pCi/g)	Uncertainty (pCi/g)	Co-60 (pCi/g)	Uncertainty (pCi/g)	Unitized Value of Unity Rule	
FR 0111031S001	1.80E-01	3.10E-02	4.13E-02	1.73E-02	1.23E-01	
FR 0111031S002	< 3.73E-02		1.29E-01	2.06E-02	1.66E-01	
FR 0111031S003	< 5.43E-02		9.87E-02	2.66E-02	1.37E-01	
FR 0111031S004	7.62E-02	2.24E-02	5.40E-02	2.60E-02	9.46E-02	
FR 0111031S005	< 3.87E-02		< 4.19E-02		6.49E-02	
FR 0111031S006	< 4.24E-02		< 4.53E-02		7.04E-02	
FR 0111031S007	< 3.81E-02		< 3.86E-02		6.08E-02	
FR 0111031S008	< 3.93E-02		< 4.74E-02		7.16E-02	
FR 0111031S009	< 5.74E-02		< 6.29E-02		9.72E-02	
FR 0111031S010	3.54E-02	2.03E-02	1.55E-01	2.38E-02	1.95E-01	
FR 0111031S011	< 4.52E-02	· · · · ·	< 4.94E-02		7.64E-02	
FR 0111031S012	4.48E-02	2.36E-02	4.29E-02	1.93E-02	6.87E-02	
FR 0111031S013	5.34E-02	2.91E-02	2.44E-01	3.20E-02	3.06E-01	
FR 0111031S014	< 6.16E-02	· ·	< 6.46E-02		1.01E-01	
FR 0111031S015	< 4.19E-02		6.70E-02	2.03E-02	9.55E-02	
FR 0111031S016	< 5.52E-02.		< 6.48E-02		9.84E-02	
FR 0111031S017	< 4.79E-02	·	< 5.21E-02		8.06E-02	
FR 0111031S018	< 4.25E-02		< 5.07E-02		7.67E-02	
FR 0111031S019	< 7.20E-02		< 7.43E-02		1.17E-01	
Mean	5.60E-02		7.49E-02		1.11E-01	
Median	4.52E-02		5.40E-02		9.55E-02	
Standard Deviation	3.21E-02		5.13E-02		5.91E-02	
Range	3.54E-02 to 1.80E-01		3.86E-02 to 2.44E-01		6.08E-02 to 3.06E-01	

DIRECT MEASUREMENTS

"<" indicates MDA value. Bold indicates positive detection value.

D. SURVEY UNIT INVESTIGATIONS PERFORMED AND RESULTS

The scan process identified four locations of potentially elevated activity. An investigation was performed for two locations using survey investigation package XR 0111-03. At location S035, ISOCS gamma scans were performed at 0.7 meters to obtain non overlapping fields of view of 1.5 m^2 , thus dividing the original 28 m² field of view into 14 gamma scans. Locations of the *in situ* scans are provided on map XR0111U3-03 (Attachment 1). Co-60 activity exceeding the investigation level of 0.36 pCi/g was identified in 3 of the 14 scans. The original scan grid was remediated and a post-remediation gamma scan was performed at 3 meters (28 m² field of view). Results of the post-remediation scan were less than the investigation level and are provided in Table 3-1 (Attachment 3).

At location C009, the original 12 m^2 field of view identified as containing potentially elevated activity was also re-scanned at a distance of 0.7 m. A total of 7 non-overlapping gamma scans were performed, dividing the area into 1.5 m² scans. Locations of the *in situ* scans are provided on map XR0111U3-04 (Attachment 1). Only 1 scan identified activity above the investigation level. The area was remediated and a post-remediation ISOCS scan was performed for the original area at 2 meters (12 m^2 field of view). Results of the postremediation scan were less than the investigation level and are provided in Table 3-1 (Attachment 3).

Four PCC/SCC pipe ends within the survey area were scanned with the ISOCS at a distance of 9 inches from each pipe to obtain 0.87 m^2 fields of view. Gamma scans identified activity levels above the investigation criteria in two of the pipes. No investigations were performed. However, the gamma analyses were compared against the EMC Unity value. Results of the evaluation are provided in Table 3-1 (Attachment 3).

E. SURVEY UNIT DATA ASSESSMENT

An analysis of the direct sample measurement results, including the mean, median, standard deviation, and sample result range, is provided in Table 2. Of the 19 soil/rock/ledge/concrete samples collected, 5 identified Cs-137 activity below the DCGL value of 2.39 pCi/g while 8 samples identified Co-60 activity below the DCGL value of 0.86 pCi/g. All other values were below the MDA. Identified sample activities or Minimum Detectable Activities are listed in Table 2. The mean and median activities were less than the DCGL for both Co-60 and Cs-137. The highest reported value for Cs-137 was less than 10% of the DCGL. Four ISOCS scan measurements were identified as exceeding the investigation level and were evaluated in Attachment 3 (Table 3-1). The measurements were compared against the EMC criteria and determined to be 38.9% of unity, passing the EMC test.

÷

For illustrative purposes, as indicated in LTP Section 5.9.3, a simplified general retrospective dose estimate can be calculated from the average residual contamination level by subtracting the mean fallout Cs-137 value $(0.19 \text{ pCi/g})^2$ for disturbed soil from the survey unit sample mean activity. This yields a negative number which is equivalent to 0.0 mrem/y. Since there is no background value for Co-60, the annual dose contribution from this radionuclide would equate to an annual dose rate of 0.49 mrem/year³. However, for purposes of demonstrating compliance with the radiological criteria for license termination and the enhanced State criteria, background activity was not subtracted from the sample analysis activity values.

This annual dose equivalent is based on LTP Table 6-11 which shows the RA contaminated soil contribution (for soils contaminated at the DCGL) to be 5.63 mrem/y. Therefore, the annual dose rate would equate to

Annual Dose Rate = 5.63 x
$$\left(\frac{0.0749}{0.86}\right)$$
 = 0.49 mrem / y

² See Attachment E to Maine Yankee Procedure PMP 6.7.8 (Reference 5).

F. ADDITIONAL DATA EVALUATION

Attachment 4 provides additional data evaluation associated with this Survey Unit, including relevant statistical information. Based on survey unit direct measurement data, this attachment provides the Sign Test Summary, Quantile Plot, Histogram, and Retrospective Power Curve.

1. The Sign Test Summary provides an overall summary of design input (Table 1) and resulting calculated values used to determine the required number (N) of direct measurements (per LTP Section 5.4.2). The Sign Test Summary is a separate statistical analysis that also calculates the mean, median, and standard deviation of the direct measurements.

The critical value and the result of the Sign Test are provided in the Sign Test Summary table, as well as a listing of the key release criteria. All of the key criteria were found acceptable with the exception that the standard deviation exceeded the design sigma. The measurements were evaluated against the EMC criteria and found to be acceptable. No additional samples were required.

- 2. The Quantile Plot was generated from the unity value data listed in Table 2. The data set and plot are consistent with expectations for a Class 1 survey unit. All of the measurements are well below the DCGL of 2.39 pCi/g Cs-137 and 0.86 pCi/g Co-60 for land inside the restricted area.
- 3. A Histogram Plot was also developed based on the unity values. This plot shows a lognormal distribution.
- 4. A Retrospective Power Curve was constructed, based on FSS results. The curve shows that this survey unit having a mean residual activity at a small fraction of the DCGL has a high probability ("power") of meeting the release criteria. Thus, it can be concluded that the direct measurement data support rejection of the null hypothesis, providing high confidence that the survey unit satisfied the release criteria and that the data quality objectives were met.

G. CHANGES IN INITIAL SURVEY UNIT ASSUMPTIONS ON EXTENT OF RESIDUAL ACTIVITY

The survey was designed as a Class 1 land survey area; the FSS results were consistent with that classification. The direct measurement sample standard deviation was greater than the design sigma. A sufficient number of sample measurements were taken and no additional measurements were required due to the power of the Sign Test and the small change in sigma.

H. LTP CHANGES SUBSEQUENT TO SURVEY UNIT FSS

The FSS of Survey Unit 3 was designed, performed and evaluated in mid 2004. The design was performed to the criteria of the LTP Revision 3 (References 2 and 4). No subsequent LTP changes with potential impact to this survey unit need to be evaluated.

I. CONCLUSION

The FSS of this survey unit was designed based on the LTP designation as a Class 1 area. The survey design parameters are presented in Table 1. The required number of direct measurements was determined for the Sign Test in accordance with the LTP. As presented in Table 2, all direct measurements were less than the DCGLs of 2.39 pCi/g Cs-137 and 0.86 pCi/g Co-60.

A Sign Test Summary analysis demonstrated that the Sign Test criteria were satisfied. The direct measurement sigma was greater than that used for design, but relative shift using the actual sigma still exceeds 3, thus indicating that a sufficient number of samples was taken.

The Retrospective Power Curve shown in Attachment 4 confirmed that sufficient samples were taken to support rejection of the null hypothesis, providing high confidence that the survey unit satisfied the release criteria and the data quality objectives were met. Attachment 4 also revealed that direct measurement data represented essentially a log-normal distribution.

The scan survey design for this survey unit was developed in accordance with the LTP Revision 3 Addenda (Reference 1) with significant aspects of the design discussed in Section B and Table 1. ISOCS scans identified four locations where potentially elevated activity exceeded the scan investigation level on Table 2-2. Attachment 3 shows the elevated areas identified and provides the results of the investigation actions. Two of the four areas were remediated and re-scanned. The post-remediation scans were less than the investigation levels. Two elevated ISOCS measurements of pipe ends in the survey unit were evaluated and determined to pass the EMC unity rule.

It is concluded that FR 0111 Survey Unit 3 meets the release criteria of 10CFR20.1402 and the State of Maine enhanced criteria.

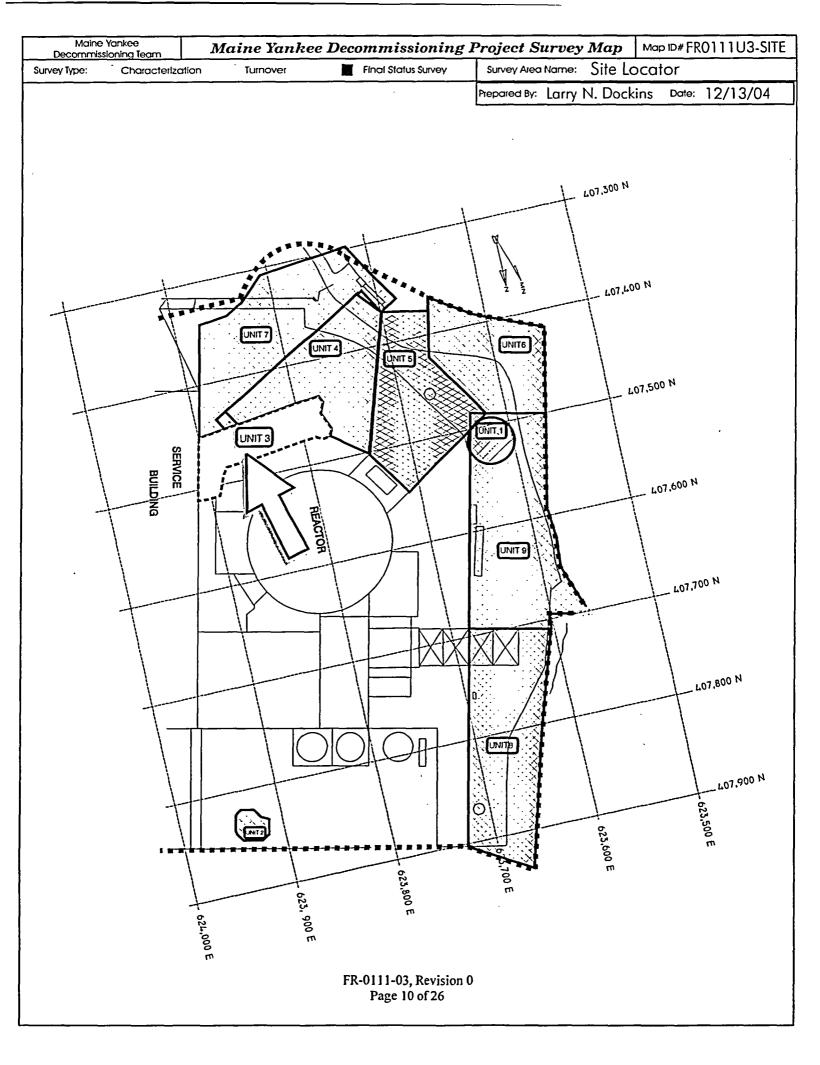
J. REFERENCES

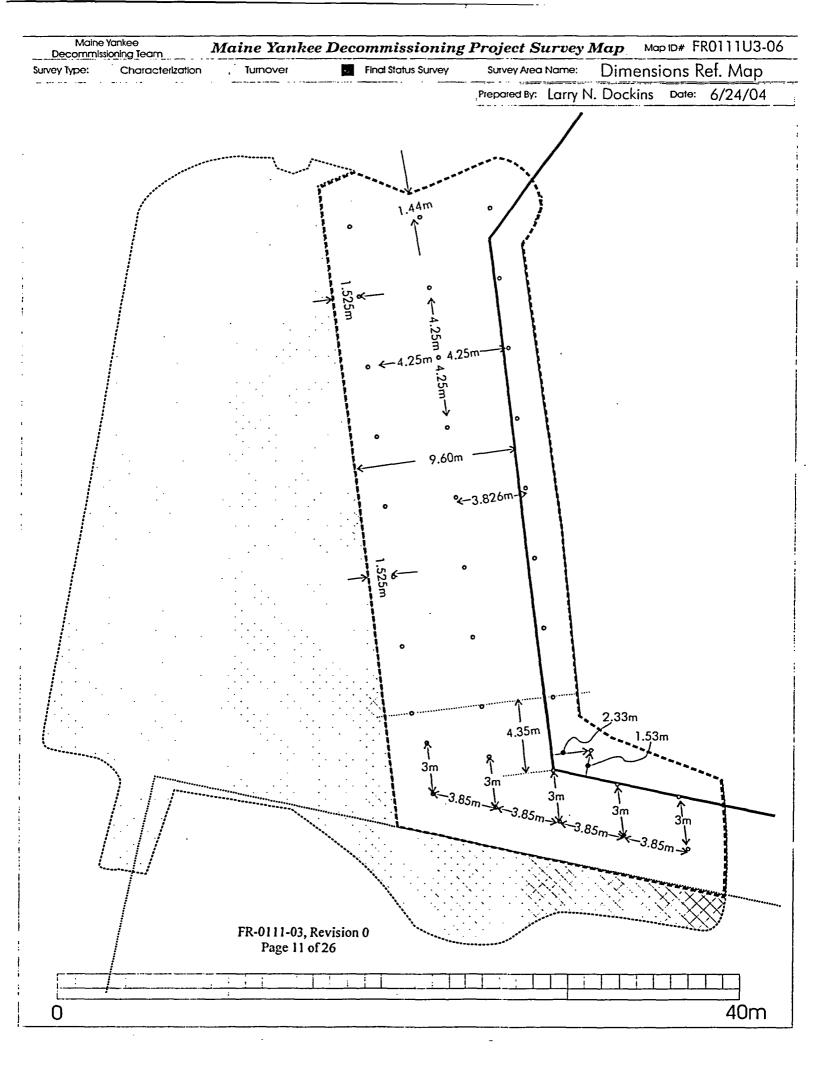
- 1. Maine Yankee License Termination Plan, Revision 3, October 15, 2002 and Addenda provided by Maine Yankee letter to the NRC, MN-02-061, dated November 26, 2002
- 2. NRC letter to Maine Yankee, dated February 28, 2003
- 3. Maine Yankee letter to the NRC, MN-03-049, dated September 11, 2003 (LTP Supplement to LTP Revision 3)
- 4. Issuance of License Amendment No. 170, NRC letter to Maine Yankee, dated February 18, 2004
- 5. Maine Yankee Procedure PMP 6.7.8, FSS Data Processing and Reporting, Attachment E, Approach for Dealing With Background Radioactivity for Maine Yankee Final Status Surveys
- 6. Maine Yankee Calculation EC-003-04

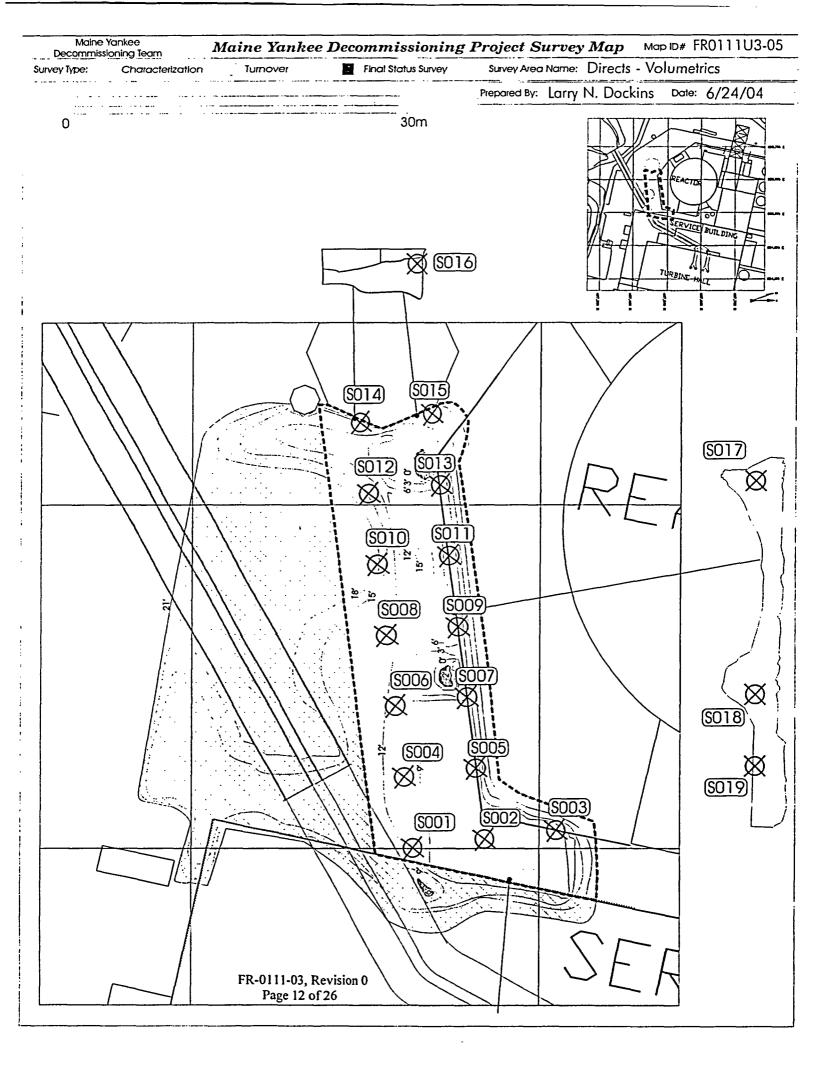
1

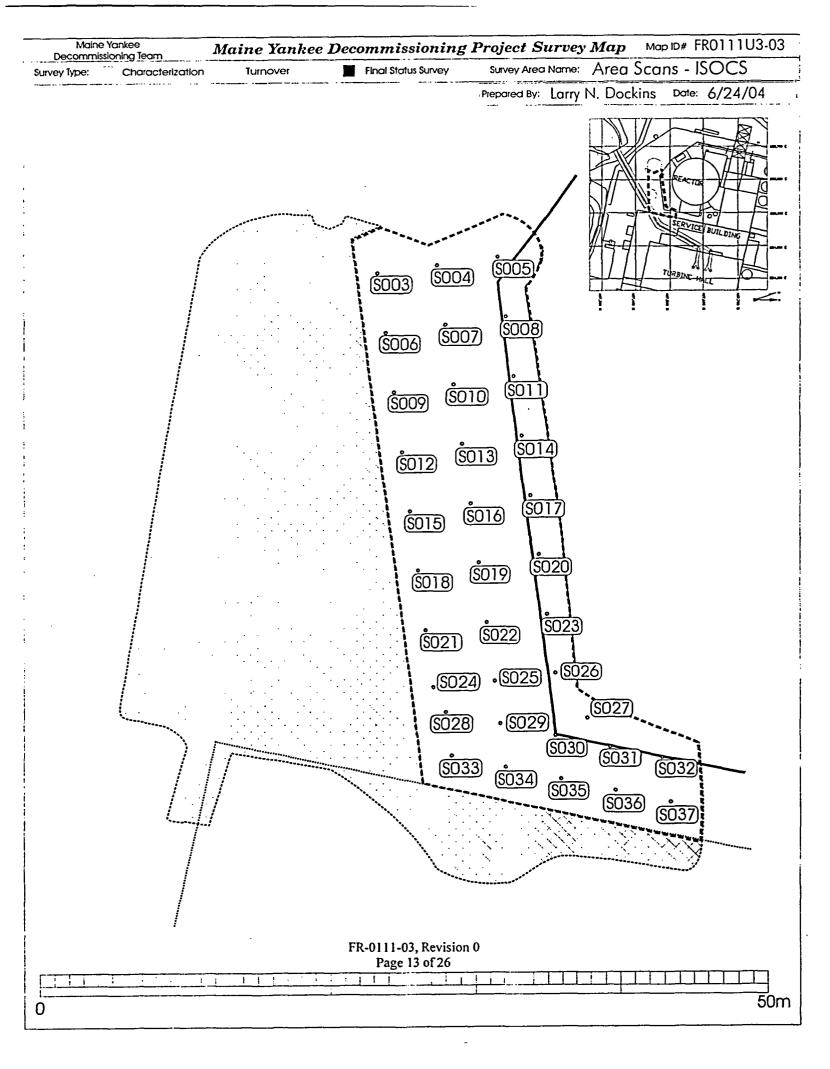
Survey Unit Maps

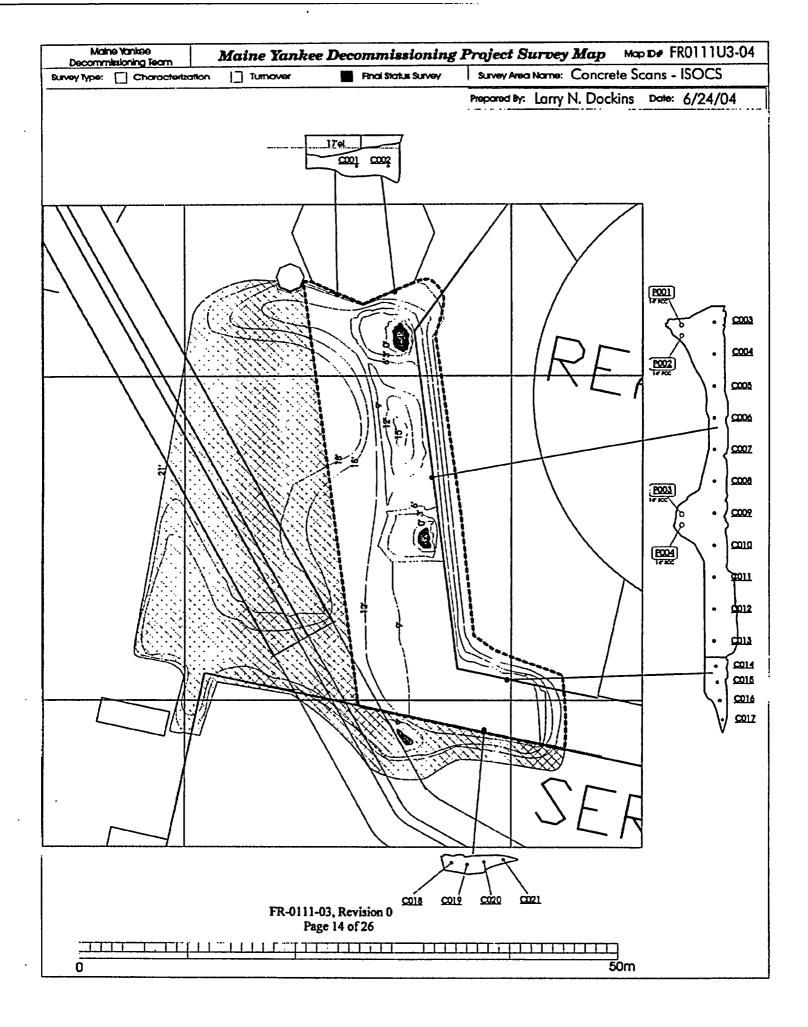
FR-0111-03, Revision 0 Page 9 of 26

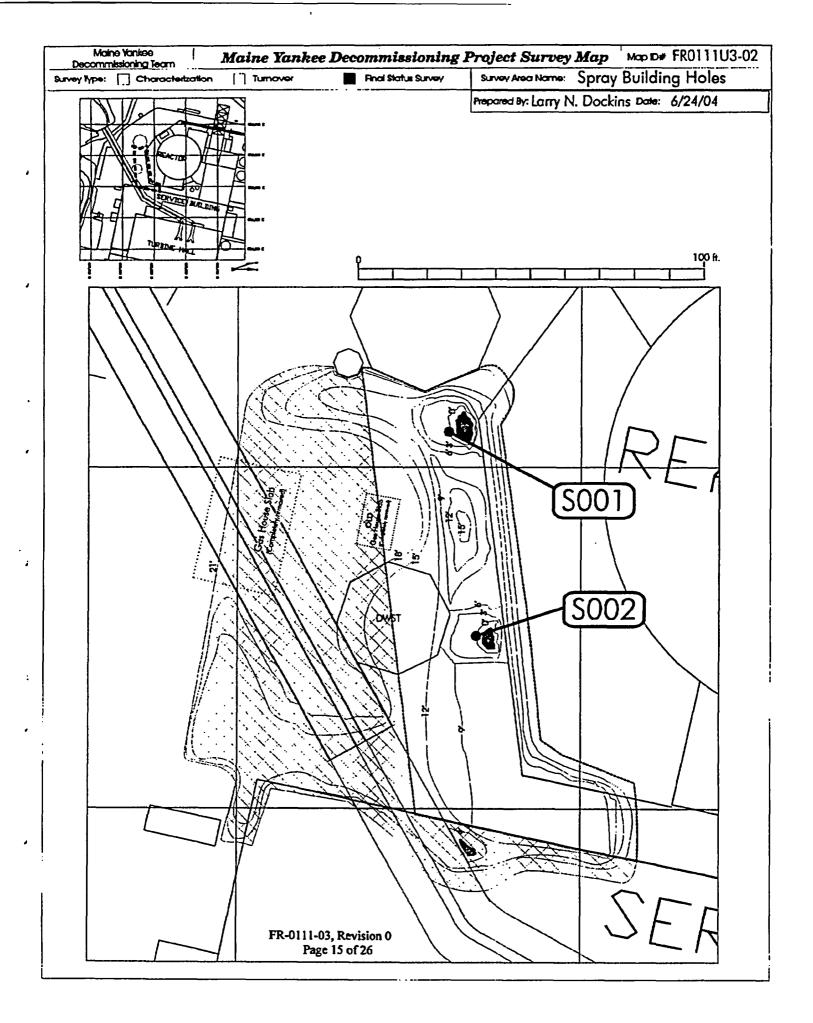


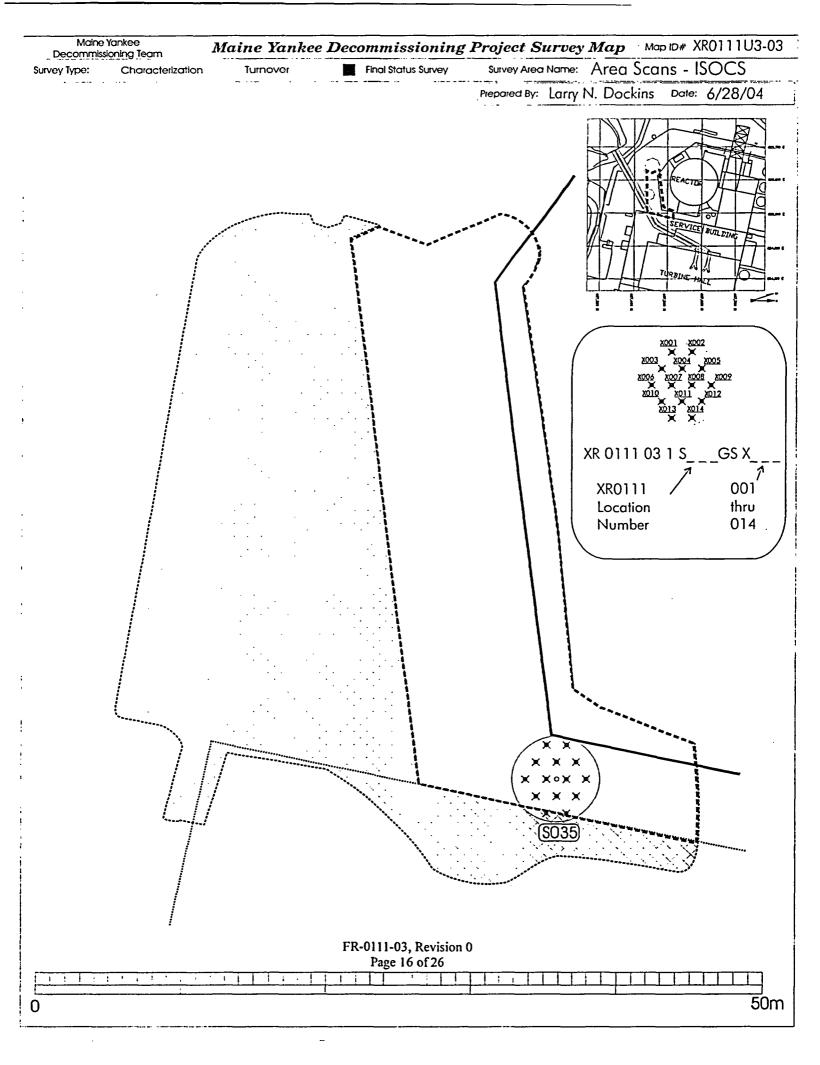


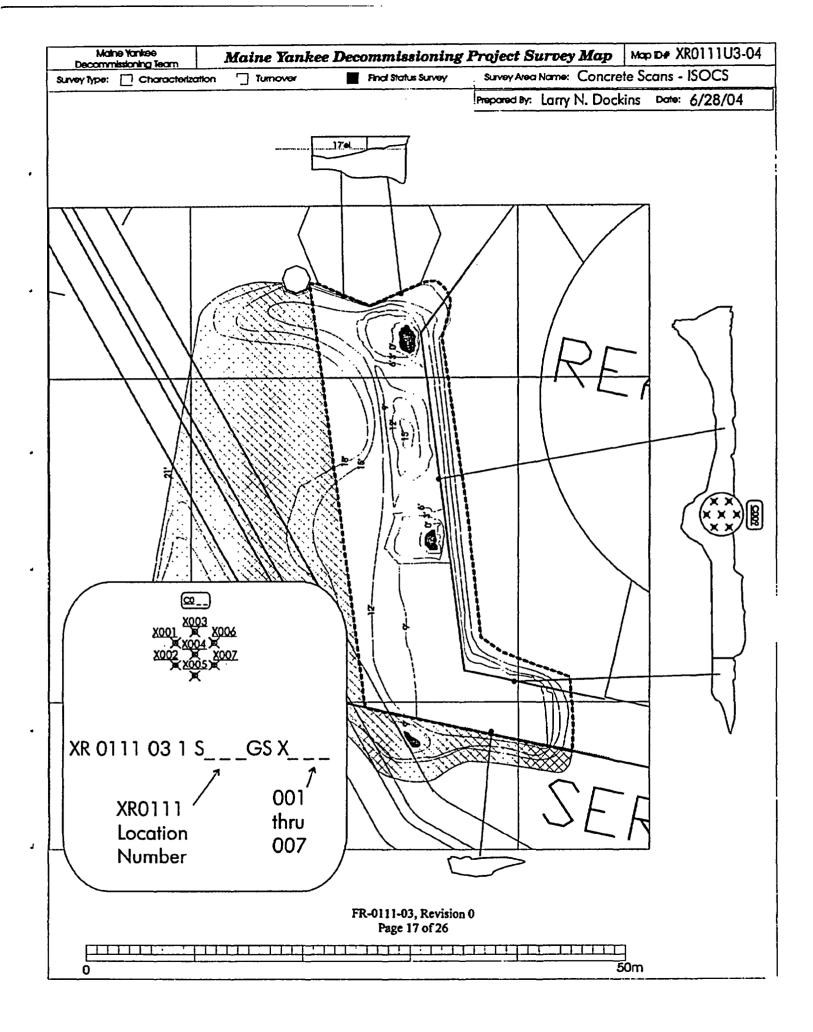












.

.

.

.

Survey Unit Instrumentation

FR-0111-03, Revision 0 Page 18 of 26

.

<u>TABLE 2-1</u>

INSTRUMENT INFORMATION

ISOCS Detectors (Field Measurements)

Detector Number	MDC (pCi/g)
7722	0.25 to 0.8

HPGe Detectors (Laboratory Analysis)

Detector Number	MDC (pCi/g)
FSS1	0.03 to 0.07
FSS2	0.03 to 0.07
DET2	0.05 to 0.07
DET3	0.05 to 0.08

<u>TABLE 2-2</u>

INSTRUMENT SCAN MDC, DCGL, INVESTIGATION LEVEL AND DCGL_{EMC}

Detector	Instrum	Comments		
Scan MDC	ISOCS 0.25 to 0.8 pCi/g (soil, concrete, ledge)	ISOCS 0.4 to 0.8 pCi/g (pipe interior)	< 50% DCGL	
DCGL	2.39 pCi/g Cs-137 0.86 pCi/g Co-60	2.39 pCi/g Cs-137 0.86 pCi/g Co-60	Approved DCGL for land areas inside the Restricted Area, (Reference 4)	
Investigation Level (ISOCS @ 3 m)	1.0 pCi/g Cs-137 0.36 pCi/g Co-60 (Reference 6)	N/A		
Investigation Level (ISOCS @ 2 m)2.2 pCi/g Cs-137 0.8 pCi/g Co-60 (Reference 6)		2.2 pCi/g Cs-137 0.8 pCi/g Co-60 (Reference 6)		
Design DCGL _{EMC}	3.58 pCi/g Cs-137 1.29 pCi/g Co-60	3.58 pCi/g Cs-137 1.29 pCi/g Co-60	DCGL x Area Factor for Class 1 survey unit, per LTP Section 5.6.3	

Investigation Table

FR-0111-03, Revision 0 Page 20 of 26

.

TABLE 3-1

INITIAL SURVEY			INVESTIGATION RESULTS						
Grid	Investigation Setpoint pCi/g	Scan Value pCi/g	Elevated Area in m ²	Area Factor	DCGL _{EMC} Unity AF	Post- Remediation Scan Co-60 pCi/g	Post- Remediation Scan Cs-137 pCi/g	Unitized Value of Unity Rule	
C009	0.8 pCi/g Co-60	3.76E-01 <u>+</u> 25.29% Co-60	12	12 2.4	2.4	1.82E-01 <u>+</u> 39.11%	<3.57E-01	3.61E-01	< DCGL
	2.2 pCi/g Cs-137	<3.39E-01 Cs-137							
S035	0.36 pCi/g Co-60	4.53E-01 <u>+</u> 25.85% Co-60	28	28 1.7	1.7	2.23E-01 +	<2.50E-01	3.64E-01	< DCGL
	1.0 pCi/g Cs-137	<3.68E-01 Cs-137	20 1.7	1.7	29.61%	-2.5015-01	5.042-01		
	0.8 pCi/g Co-60	1.25E+00 <u>+</u> 19.07% Co-60	1	12	12	N/A	N/A	1.78E+00	1.40E-01
P001	2.2 pCi/g Cs-137	7 .95E-01 <u>+</u> 45.35% Cs-137		1 12					
P002	0.8 pCi/g Co-60	1.24E+00 <u>+</u> 19.45% Co-60		12	12	N/A	N/A	1.77E+00	1.38E-01
	2.2 pCi/g Cs-137	<7.87E-01 Cs-137							
						Co-60 Mean pCi/g	Cs-137 Mean pCi/g		
		·····				7.49E-02	5.60E-02	1.11E-01	1.11E-01
	EMC Unity Sum						3.89E-01		

INVESTIGATION TABLE

- NOTES 1. "<" indicates MDA value. Bold indicates positive detection value. 2. The ISOCS scan results for C009 were below the investigation level for 2 meters. However, the scan was investigated and therefore is being included for completeness.
 - 3. The DCGL_{EMC} Unity Value was calculated by subtracting the survey unit mean from the sample results. The survey unit mean was calculated using the data shown in Table 2.

.

Statistical Data

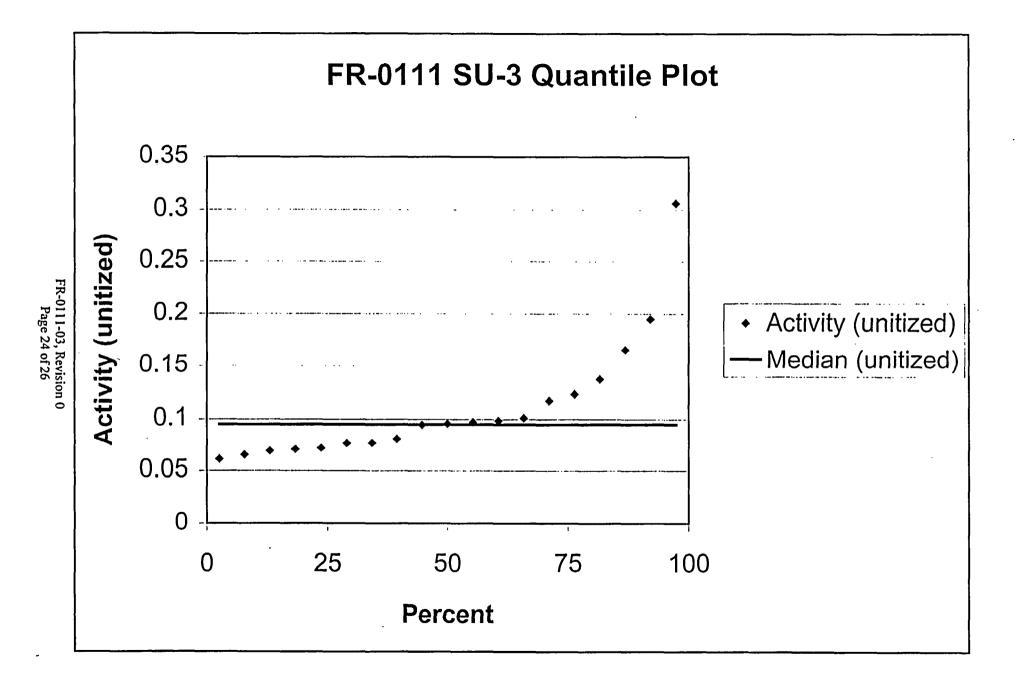
.

FR-0111-03, Revision 0 Page 22 of 26

-

Evaluation Input Value	es a la l	Comments
Survey Package:	FR0111	Yard West Excavations
Survey Unit:	03	
Evaluator:	DA	
DCGL _w :	1.00E+00	Unity
DCGL _{ernc} :	1.50E+00	AF x Unity
LBGR:	9.12E-01	91% of DCGL
Sigma:		Unitized (0.07 pCi/g / 2.39 pCi/g)
Type I error:	0.05	
Type II error:	0.05	
Nuclide:	UNITY	
Soil Type:	N/A	· · · · · · · · · · · · · · · · · · ·
Calculated Values	<u> </u>	Comments
Z _{1-a} :	1.645	
Z _{1-β} :	1.645	· · · · · · · · · · · · · · · · · · ·
Sign p:	0.99865	
Calculated Relative Shift:	3.0	· · · · · · · · · · · · · · · · · · ·
Relative Shift Used:		Uses 3.0 if Relative Shift is >3
N-Value:	11	
N-Value+20%:	14	· · · · · · · · · · · · · · · · · · ·
Sample Data Values		Comments
Number of Samples:	19	
Median:	9.55E-02	
Mean:	1.11E-01	
Net Sample Standard Deviation:	5.91E-02	
Total Standard Deviation:		Sum of samples and reference
Maximum:	3.06E-01	
Sign Test Results		Comments
Adjusted N Value:	19	
S+ Value:	19	
Critical Value:	13	
Sign test results:	Pass	
Criteria Satisfaction		Comments
Sufficient samples collected:	Pass	
Maximum value <dcgl<sub>w:</dcgl<sub>	Pass	· · · · · · · · · · · · · · · · · · ·
Median value <dcgl<sub>w:</dcgl<sub>	Pass	
Mean value <dcgl<sub>w:</dcgl<sub>	Pass	· · · · · · · · · · · · · · · · · · ·
Maximum value <dcgl<sub>emc:</dcgl<sub>	Pass	
Total Standard Deviation <= Sigma:	Investigate	
Criteria comparison results:		Total SD does not affect sample size
Final Status	L INVESTIGATE	STANCE CONTRACTOR CONTRACTORY NAMES AND ADDRESS OF
	here and a start of the second	Suprov Unit Passos
The survey unit passes all conditions:	investigate	Survey Unit Passes

Survey Package FR0111 Unit 3 UNITY Soil Sign Test Summary



One-Sample T-Test Report

- -

Page/Date/Time 2 12/17/04 9:45:36 AM Database Variable C2

Plots Section

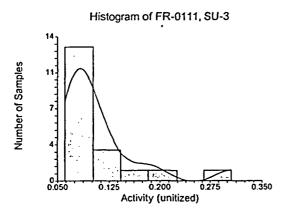
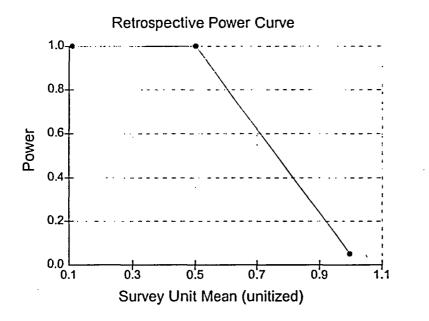




Chart Section



.